Volume 20 Study D-I-B

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

ECOLOGY OF REARING FISH

by

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TABLE OF CONTENTS

Job No. D-I-B (cont.) Page

RESEARCH PROJECT SEGMENT

State:	ALASKA	Name:	Sport Fish Investigations of Alaska
Project No.:	F-9-11		
Study No.:	D-I	Study Title:	A STUDY OF LAND USE ACTIVITIES AND THEIR RELATIONSHIP TO THE SPORT FISH RESOURCES IN ALASKA
Job No.:	D-I-B	Job Title:	Ecology of Rearing Fish

Period Covered: July 1, 1978 to June 30, 1979

ABSTRACT

The job Ecology of Rearing Fish conducts research on various effects of land use activities on juvenile salmonids in the small stream environment. The aspects that are being investigated include: effects of logging slash removal on the rearing fish environment, the value of small spring-fed tributaries to overwinter survival of rearing salmonids, the effects of forest canopy removal on the winter rearing environment, and baseline studies of aquatic productivity in the Keta, Wilson and Blossom rivers.

Hand removal of logging slash resulted in an 80% decrease in rearing Dolly Varden, *Salvelinus malma* (Walbaum), populations in Spring Pond Creek, a small tributary near Sitka. Changes in benthos densities, drift rates, benthos composition and morphology of the stream were also documented. Findings of this study have been written and submitted for formal publication.

Baseline environmental studies of the Keta River, in relation to the proposed U.S. Borax Molybdenum Mine, have been accomplished for the 1978 field season. Because of the large volume of samples collected and the lengthy analysis required, a report will not be forthcoming until early 1980.

A study of winter stream temperatures in relation to forest canopy removal was to be initiated using satellite remote sensing capabilities. This study has been postponed due to equipment failure.

Studies of overwinter survival of juvenile Dolly Varden indicate that mortality is much greater in run-off streams than in ground-water streams. Due to changes in fish populations resulting from experimental debris removal, work on winter survival could not be conducted. Consequently, the project will be relocating this study to a more suitable site.

BACKGROUND

Surveys of 21 logged watersheds in Southeast Alaska during the 1971-1972 field season indicated that a number of issues regarding the impact of logging on the aquatic environment had not been totally addressed. The surveys (Reed and Elliott, 1972) showed that many streams in Southeast Alaska had been altered by heavy accumulation of organic debris and slash from clear-cutting operations. In most cases the debris accumulations were large enough to warrant removal in order to restore the stream to its original condition.

Another issue that warranted investigation was the value of small streams, especially spring-fed streams, to winter survival of juvenile salmonids. Past research at Hood Bay Creek, Alaska, suggests that young Dolly Varden, *Salvelinus malma* (Walbaum), and coho salmon, *Oncorhynchus kisutch* (Walbaum), migrate upstream to warmer, spring-fed tributaries to overwinter (Blackett, 1968). Temperature monitoring of the spring-fed streams in Hood Bay, revealed stable temperatures of 5.0° to 6.1°C during the winter, while the main stream developed heavy ice formations (Armstrong and Elliott, 1972).

The effects of canopy removal on the winter stream environment is also poorly understood. Green (1950) indicates that lower temperatures are experienced during the winter in exposed streams, which may result in detrimental ice conditions and delay development of incubating salmon eggs.

To further investigate the effects of debris removal, winter temperature regimes, and canopy removal on juvenile salmonid populations, the Sport Fish Division created the Job D-I-B, Ecology of Rearing Fish, under the auspices of the Land Use Study. One year's preliminary work was conducted at Kadashan Creek, where methods of making population estimates were investigated (Elliott and Reed, 1973). The study was then moved to Starrigavan Creek near Sitka, where several small streams were selected and weired for future studies.

The first year at the Starrigavan site was devoted to the study of seasonal movement patterns of juvenile fish and established that many juvenile coho and Dolly Varden seek tributaries during the fall months (Elliott and Reed, 1974). Determination of seasonal population dynamics during 1973, 1974 and 1975 was conducted to provide baseline data for studies of overwinter survival and debris removal (Elliott, 1976).

Project personnel monitored fish and invertebrate populations in Spring Pond Creek after logging debris was removed in July, 1976. Analysis of Dolly Varden populations indicate that a distinct downward trend in the char population has occurred since 1976. Also, changes in the macrobenthos community have been observed, with some species becoming more common while other species disappeared. Drift rates of some species were also affected and changes in streambed composition were noted. To determine long term effects of debris removal these parameters will be monitored through 1980.

In March 1976, the U.S. Borax and Chemical Corporation announced its interest in a molybdenum deposit at a one-square-mile site 72 km (45 mi) east of Ketchikan. Construction of a mining complex in the area would employ 700 to 1,000 people, and the mining operation would employ about 500 full-time, year-round workers. U.S. Borax Executive Vice President for Operations said the cost of constructing an open pit mine, a concentrating plant to process 30,000 tons of ore per day, a dock, and other support facilities is currently estimated at $250 million.

This project is concerned about the possible impacts of open pit mining on the fish populations and fish habitat in the Keta, Wilson and Blossom rivers, all of which support substantial runs of salmon, trout and char.

In 1977, the U.S. Fish and Wildlife Service awarded this project funds to conduct research on aquatic invertebrates and fish populations in the Keta, Wilson and Blossom rivers. Studies of these parameters were commenced in May, 1978, and conducted through October, 1978. Additional field work is scheduled for April, 1979, and findings of this study will be made available in March, 1980.

RECOMMENDATIONS

Research

1. Determine the effects of logging debris removal on junenile salmonid populations in small streams by:

    a. Conducting systematic population estimates in Spring Pond Creek to monitor changes in population size and structure after debris removal.

    b. Determine biomass, standing crop, species diversity and distribution of macrobenthos after debris removal.

2. Collection of base-line data on the Keta, Wilson and Blossom rivers in relation to the proposed U.S. Borax Molybdenum Mine by:

    a. Collection of benthos and drift at selected sites on the Keta, Wilson and Blossom rivers.

    b. Perform population estimates at selected sites on the Keta River, in Beaver Creek and North Creek on the Blossom River.

    c. Collect samples of invertebrates and salmonids from Beaver Creek and North Creek for heavy metals analysis.

3. Determine if there are differences in aquatic productivity of tributary streams in logged and unlogged watersheds by:

    a. Conducting population estimates in logged and unlogged tributaries within the same watershed.

b. Determining the species diversity, community structure, and number of benthic invertebrates at each site using CDS and drift samples.

c. Determine the age, maturity and feeding habits of juvenile salmonids at each site.

d. Determine the biomass and density of juvenile salmonids at each site.

e. Determine the canopy composition at each site.

f. Evaluate in-stream habitat at each site as a measure of cover.

g. Repeat these procedures on at least 10 logged watersheds in the Tongass Forest.

4. Determine the overwinter survival of rearing salmonids in logged and unlogged watersheds by:

a. Returning to watersheds examined in No. 3 (above) and conducting population estimates during the months of April through June 15.

b. Compare fall and spring estimates using the most appropriate statistics to determine if differences in survival exist in small tributaries.

5. Determine the status of rearing Dolly Varden populations in Montana Creek by:

a. Determine the distribution, relative abundance, and CPUE of Dolly Varden char in Montana Creek.

b. Perform population estimates in selected areas during July and September using established techniques.

c. Results of estimates and CPUE data will be compared to population statistics gathered from other watersheds to determine the status of Dolly Varden.

d. Conduct foot surveys to determine the number of spawning char during October and November.

Management

1. Continue to publish the results of research gathered by this job so that it can be made available to land managers.

2. Results of research on the effects of logging slash removal from tributary streams in abandoned logging areas indicate a negative effect on populations of juvenile Dolly Varden. Debris removal at the Spring Pond Creek study site resulted in an 80% decrease in

rearing char populations. This project recommends that no slash removal be conducted in abandoned logging areas unless blockage to migrating adults can be demonstrated.

OBJECTIVES

1. Determine the effects of logging debris removal on Juvenile salmonid populations.

2. Determine the importance of spring-fed tributaries to the overwinter survival of rearing fish.

3. Determine methods for future research on the effects of canopy removal on temperature and ice conditions of small streams during the winter months.

4. Determine the distribution, abundance and species diversity of macrobenthos and its relationship to rearing fish populations.

5.. Prepare information on the effects of environmental perturbation on juvenile char life history and macrobenthos.

FINDINGS

Debris Removal Study

A report on information collected on this objective was made available for publishing this year. The abstract of the report is:

> Logging debris that had been deposited in a small tributary stream during clear-cutting operations in 1970-1971 was removed by hand in 1976. Population estimates showed that debris removal resulted in an 80% decrease in the juvenile Dolly Varden, *(Salvelinus malma)* population within two years' time. Debris removal also caused changes in streambed composition, a reduction in stream surface area, and a temporary reduction in macrobenthos population and their drift rates.
>
> Though removal of debris substantially reduced the amount of cover for Dolly Varden, only a few fish emigrated from the stream. It is suspected that the observed reduction in population resulted from mortality due to increased social and competitive interaction and as a result of predation by mustellids and birds. (Elliott and Hubartt, in press).

Aquatic Insect Studies

Research information on aquatic invertebrates collected by this job was made available for publication. The abstract of the report is as follows:

Large numbers of *Polypedilum* larvae (Diptera: Chironomidae) often found in the redds of pink salmon *(Oncorhychus gorbuscha)* have been suspected as predators on developing eggs and alevins. Dead eggs and alevins and live alevins were removed from spawning gravels and examined for the presence of *Polypedilum* larvae. Larvae were most commonly attached to dead pink salmon eggs that were infested with *Saprolegnia* fungi. Larvae also attacked some dead alevins, but no evidence of predation on live fry was observed. (Elliott and Bartoo, in press).

Other information on the distribution and abundance of aquatic insects in Southeastern Alaska has been compiled for a future publication entitled: Records of Stoneflys (Plecoptera) from Southeastern Alaska.

Canopy Removal Study

A research proposal designed to test the application of satellite remote sensing of watershed temperatures in logged and unlogged stream systems was submitted to the Geophysical Institute at the University of Alaska, Fairbanks. Collection of ground truth data, to be conducted this winter, was cancelled when the satellite malfunctioned.

Baseline Aquatic Studies of the Keta River

All data collection that was scheduled for the 1978 field season has been accomplished and samples are now in the process of being analyzed. Forthcoming results will be submitted to the U.S. Fish and Wildlife Service in March 1980. The report and its recommendations will be available to the public and industry at that time.

Winter Survival Studies

Comparative winter survival estimates for two tributary streams are given in Elliott (1978). No work was done on this objective at Starrigavan Creek this field season due to fish population changes at the study site. The project will be relocating its study on winter survival to other more suitable areas.

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